Eggs for breakfast: long-term impact on body weight

Final Report

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A report for Australian Eggs Limited
by Associate Professor J.B. Keogh and
Professor Peter Clifton

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Foreword

This project was conducted to investigate the impact of consuming 2 eggs for breakfast on 5 days per week over a 6- month period on body weight, body composition, glucose and lipids and Vitamin D status. Prior to conducting this study there was evidence to suggest that a higher protein diet helps people lose weight and maintain weight loss. However, few studies had examined the effects of an energy restricted diet with eggs for breakfast on weight loss. The primary outcome of this study was weight loss with secondary outcomes of fasting body composition, blood lipids, glucose and Vitamin D status.

This project was requested by Australian Eggs Limited the producer owned company that integrates marketing, research and development and policy services for its stakeholders. The research and development component, of which this Project forms part, is funded by the Australian Government.

This report is an addition to Australian Eggs Limited's range of peer reviewed research publications and an output of our Innovation program, which aims to support improved efficiency, sustainability, product quality, education and technology transfer in the Australian egg industry.

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Australian Eggs Limited provided the funds which supported this project.

About the Authors

A/Prof Jennifer Keogh was appointed A/Professor of Dietetics and Human Nutrition in the School of Pharmacy and Medical Sciences at UniSA in 2010. Her research is on the prevention and management of chronic disease using dietary change to achieve health benefits in obesity, diabetes and cardiovascular disease. Her most recent publications are on the use of intermittent dieting as a strategy for weight loss and diabetes management. She has 129 published articles, h-index of 45 and 7210 citations (Google Scholar September 2018). A/Prof Keogh has worked collaboratively with industry over many years.

Professor Peter Clifton is a physician and nutrition scientist. He is an Adjunct Research Professor in nutrition at the University of South Australia. He has clinical and research interests in the prevention and treatment of cardiovascular disease, lipid disorders, type 2 diabetes and obesity. He has over 300 published articles.

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Abbreviations (Update as appropriate)

BMI	Body mass index
CTF	Clinical Trial Facility
DEXA	Dual energy X-ray absorptiometry
SD	Standard Deviation
HDL	High Density Lipoprotein
LDL	Low Density Lipoprotein

Executive Summary

The aim of the study was to investigate, over 6 months, the impact of consuming 2 eggs for breakfast on 5 days per week compared with eating cereal for breakfast on body weight, body composition, glucose and lipids and Vitamin D status.
The primary outcome of this study was weight loss. Secondary outcomes were body composition, fasting blood lipids, glucose and Vitamin D status. Body composition (lean and fat mass) by DEXA was measured at baseline but could not be measured at 6 months because of restrictions imposed by COVID-19.

Methods
This was a randomised parallel study of two energy restricted diets that compared consuming 2 eggs for breakfast on 5 days per week compared with eating cereal for breakfast, over a 6- month period. Both diets had a similar energy content.

Measurements
Participants attended the UniSA's Clinical Trial Facility in the morning having fasted overnight for the measurement of weight, height and DEXA and to have blood samples taken.

Results
Participants
There were 466 enquiries following advertisements on social media, in newspapers and on the radio. Seventy-seven people were not eligible on preliminary screening or did not want to participate once they were informed about what was required in the study. Further information was sent to 389 participants of whom 131 returned the Diet and Lifestyle Questionnaires and were assessed for eligibility. One hundred and ten participants, age 56 ± 16 years, BMI 34 ± 6 kg.m^2, 84 women and 26 men, were randomised to commence the study.

Outcomes
Seventy-six participants completed the study, 33 in the egg group and 43 in the cereal group. Weight loss in completers was 8.1 kg (± 7.0 kg) in the egg group and 7.3kg (± 4.0 kg) in the cereal group. Percent weight loss was 8.8 ± 6.4% in the egg group and 7.6 ± 4.6% in the cereal group.
There was a significant effect of time (P< 0.001) but there was no differential effect of diet (p= 0.56). Gender and baseline BMI had no significant effect when added as covariates. The egg group had 2 individuals with very large weight losses of >20kg which made the data skewed. Removal of these 2 individuals normalised the data but had no effect on the results but the egg weight loss was slightly lower at 6.7 kg ± 4.6 kg. The percentage weight loss was very similar in the normalised group 7.9% eggs and 7.6% cereal. Weight loss had no effect on glucose and lipids which were all normal to begin with. Vitamin D was normal (55 ± 18 nmol/L) at baseline rose at 3 months and fell at 6 months but still remained higher than baseline (P< 0.001 for time). There was no difference between the two groups. Vitamin D levels were inversely correlated with BMI (r= -0.22, p= 0.025) and positively with age (r= 0.26, p= 0.009) and change in Vitamin D was positively correlated with weight change at 3 and 6 months (r= 0.46 and r= 0.41 both p<0.001). Withdrawals were 21 for eggs and 13 for cereal (p= 0.1). More than 70% of the participants were obese (79 of 110) with BMI 36.3 ± 5.8 kg/m^2. In a post-hoc analysis when only obese participants were included in the analysis of vitamin D there was an effect of time (p< 0.01) and a time by diet interaction (p< 0.04) such that participants on the egg diet maintained the increase in vitamin D levels at 6 months.

Overall Conclusions

Both eggs and cereal eaten for breakfast during an energy restricted diet resulted in similar weight loss. There were no adverse effects on total and LDL cholesterol which did not change. Vitamin D rose at 3 months and declined at 6 months but remained higher than at the start of the study. In a post-hoc analysis participants with obesity on the egg diet maintained a higher vitamin D level at 6 months than those in the cereal group. This remains to be clarified in a prospective study.

1 Introduction

Obesity

Australia is experiencing rising rates of overweight and obesity. In 2017-18, two thirds (67.0%) of Australian adults were overweight or obese (12.5 million people), an increase from 63.4% in 2014-15 (AIHW 2019). All these individuals are at increased risk of developing diabetes, heart disease and certain cancers. Development of evidence based dietary strategies for weight loss is important given that many adults are trying to lose weight. A recent systematic review and meta-analysis of personal weight control attempts worldwide estimated that 42% of adults reported trying to lose weight (Santos, Sniehotta et al. 2017).

Breakfast

Eating breakfast can assist individuals to lose weight and maintain weight loss (Megson, Wing et al. 2017, Paixao, Dias et al. 2020). There are few recent data on the numbers of people who eat breakfast in Australia. In the Australian Health Survey (2011-12), breakfast cereals were eaten by 36% of the population with a further 7% eating porridge. Data from the 1995 National Nutrition Survey indicates that more than 77% of people ate breakfast but fewer than 10% had a cooked breakfast, with cereals, bread and milk being the most frequently eaten foods. Few studies have examined the effects of an energy restricted diet with eggs for breakfast on weight loss. In an 8-week study greater weight loss of ~1kg was reported in participants on an energy restricted diet that included eggs but there was no effect on weight of including eggs without energy restriction (Vander Wal, Gupta et al. 2008). However this is a small difference over a short time period and longer duration needs to be explored as the finding may have occurred by chance alone. A potential benefit of eggs eaten at breakfast may be that they can help satisfy hunger and improve satiety. In an earlier study we demonstrated that when eggs were eaten for breakfast there was a significantly reduced energy intake at lunch compared with a cereal breakfast with the same energy content (4518kj ± 1593 vs 5284kj ± 1814, p=0.001). Satisfying hunger and keeping individuals fuller for longer (increased satiety) is important to help individuals sustain an energy restricted weight loss program.

Vitamin D

Vitamin D deficiency has been well described in obese people which may be due to a dilution effect of the greater volume of fat, liver and muscle (Vranić, Mikolašević et al. 2019). Data from the 2011-2013 Australian Health Survey reported that 20% of adults (19% men; 21% women) were vitamin D deficient (<50nmol/L) and 43% were classified as Vitamin D insufficient (45% men; 42% women) (Malacova, Cheang et al. 2019). Adequate Vitamin D levels are important for bone health and increasing egg intake may improve Vitamin D status. The vitamin D content of eggs is 8.2µg per serve (2 eggs – edible portion 104g) or 7.9µg per 100g. As the adult adequate intake (AI) in Australia is 10µg, one serving of eggs provides 82% of the AI.

1.1 Aim

To investigate the impact of consuming 2 eggs for breakfast on 5 days per week over a 6- month period on body weight, body composition, glucose and lipids and Vitamin D status.

Outcomes

The primary outcome of the study is weight loss. The study will show if greater weight loss is achieved on an energy restricted weight loss diet that includes eggs ≥5 days per week compared with an energy restricted weight loss diet that includes cereal for breakfast.
Secondary outcomes are the effects of the diet on blood lipids and glucose and Vitamin D status.

1.2 Hypothesis

The hypothesis was that the participants who regularly eat eggs for breakfast would have greater weight loss, increased lean mass preservation and better Vitamin D status relative to participants who regularly eat cereal for breakfast.

1.3 Design

This was a randomized parallel design study.

1.4 Methods

Participants were randomized to one of two energy restricted diets, either a diet containing 2 eggs for breakfast on 5 days/week or a diet containing breakfast cereal for breakfast.

1.4.1 Population

The participants in this study were overweight or obese adults. This sample size was based on a previous weight loss study and we anticipated a difference of 2kg between the groups (Noakes, Keogh et al. 2005). We anticipated a drop-out rate of 10-15% and 110 participants commenced so that 95-100 participants would complete the study.

1.4.2 Inclusion Criteria

Participants were >18 years, overweight (BMI >25 kg/m^2), who had no health conditions likely to affect the study outcomes, had no food allergies and were able to eat eggs and breakfast cereal. Participants self-reported their health status.

1.4.3 Exclusion Criteria

Exclusion criteria were previous surgery for weight reduction, type 1 or type 2 diabetes, women who were or wished to become pregnant and women who were breast feeding, participant reporting they were unwell or receiving medical treatment or were participating in any ongoing dietary studies. Participants were also excluded if they were unable to eat the study foods which were eggs and cereal.

1.4.4 Ethics

Ethical approval from the University's Human Research Ethics Committee was received before advertising for participants commenced.

1.4.5 Recruitment

Participants were recruited using print and social media, the radio and advertising flyers on the University of South Australia's campus.

1.5 Health Status

Following initial contact with the CTF participants were asked to complete a Diet and Lifestyle Questionnaire to determine if they were eligible to participate in the study.

1.5.1 Protocol

Participants completed a Diet and Lifestyle Questionnaire to determine if they were eligible to participate in the study. They attended the UniSA Clinical Trials Facility (City East campus) on 7 occasions over 6 months. At the first and last visits participants had weight, height (once only) and body composition measured and a blood sample taken. Body composition was measured using DEXA. A blood sample was taken for measurement of glucose, lipids and Vitamin D. Participants fasted from 8pm the night before each visit, with only water permitted. The dietary intervention was explained during the first visit. Participants were asked to keep daily checklists of their breakfasts during the study.

1.5.2 Diets

The diets contained a variety of everyday foods including:

1) Eggs, breakfast cereal, wholemeal bread, margarine, milk, fruit, meat, fish, chicken (or equivalent), vegetables and salad yoghurt, potato (or equivalent) **OR**
2) Breakfast cereal, wholemeal bread, margarine, milk, fruit, meat, fish, chicken (or equivalent), vegetables and salad, yoghurt (or equivalent) potato (or equivalent)

Compliance to both breakfasts was assessed from the compliance checklists completed by the participants. The cereal group were asked to avoid eating eggs for breakfast but could include eggs at other meals Both eggs and the breakfast cereal were provided for approximately half of the study until the advent of COVID-19. Following the social closure of the university's research facility vouchers were provided instead so individuals could purchase these foods during their usual grocery shopping for the remainder of the study.

1.5.3 Biochemistry

Blood samples were collected and analysed by a certified commercial laboratory (Clinpath Pathology, Mile End SA 5031 Australia).

1.6 Participant Support

Participants were given a $150 honorarium on completion of the study in appreciation of their time.

1.7 Statistics

Results are expressed as Mean ± SD unless otherwise stated.
Analysis of variance (ANOVA) with repeated measures was used to determine the effect of time and treatment. Statistical analysis was performed using SPSS 24.0.

2 Results

2.1 Participants

There were 466 enquiries following advertisements on social media, in newspapers and on the radio. Seventy-seven people were not eligible on preliminary screening or did not want to participate once they were informed about what was required in the study. Further information was sent to 389 participants of whom 131 returned the Diet and Lifestyle Questionnaires and were assessed for eligibility. One hundred and ten participants, age 56 ± 16 years, BMI 34 ± 6 kg.m^2, 84 women and 26

men, were randomised to commence the study. There was a drop-out rate of 30%. Seventy-six participants completed the study. Withdrawals which were 21 for eggs and 13 for cereal were not statistically different (p= 0.1).

2.2 Baseline characteristics of participants

One hundred and ten participants, 56 ± 16 years range 18 - 78 years, 84 women and 26 men were randomised to commence the study. One hundred and seven participants attended for the first visit; 53 in the eggs for breakfast group and 54 in the cereal for breakfast group. Three participants did not attend for their first visit. Baseline characteristics are presented in Table 1, Table 2 and Table 3.

Table 1 Baseline characteristics- All

	Eggs (n=54) Mean	SD	Cereal (n=56) Mean	SD
Age- years	54	15	57	15
Weight- kg	94	21	93	18
BMI- kg/m^2	34	7	34	6
Glucose- mmol/L	5.0	0.7	4.9	0.5
Total Cholesterol- mmol/L	5.3	0.9	5.5	0.9
HDL- mmol/L	1.5	0.3	1.5	0.3
LDL- mmol/L	3.2	0.8	3.5	0.8
Triglycerides- mmol/L	1.1	0.4	1.3	0.7
Vitamin D- nmol/L	54	19	55.9	17.1

Blood samples could not be obtained from 5 participants and insufficient blood was obtained from one participant. The laboratory omitted to analyse 2 samples for glucose, 4 samples for total cholesterol, triglycerides and Vitamin D. In addition, eight samples for HDL and LDL were omitted.

Table 2 Baseline characteristics- Women

	Eggs (n = 40) Mean	SD	Cereal (n= 44) Mean	SD
Age- years	55	15	56	15
Weight- kg	89	20	91	19
BMI- kg/m^2	34	8	34	6
Glucose- mmol/L	4.8	0.6	4.9	0.4
Total Cholesterol- mmol/L	5.3	0.9	5.4	0.8
HDL- mmol/L	1.6	0.3	1.5	0.3
LDL- mmol/L	3.2	0.8	3.3	0.8
Triglycerides- mmol/L	1.1	0.4	1.1	0.6
Vitamin D- nmol/L	53	20	54	17

Table 3 Baseline characteristics- Men

	Eggs (n=14) Mean	SD	Cereal (n=12) Mean	SD
Age- years	52	16	61	13
Weight- kg	108	17	101	11
BMI- kg/m^2	34	5	33	3
Glucose- mmol/L	5.5	0.7	5.1	0.5
Total Cholesterol- mmol/L	5.1	0.8	5.8	0.9
HDL- mmol/L	1.3	0.2	1.2	0.3
LDL- mmol/L	3.1	0.7	3.8	0.9
Triglycerides- mmol/L	1.3	0.4	1.6	0.7
Vitamin D- nmol/L	56	18	62	17

2.3 Weight and Vitamin D at 3 months

Eighty-seven participants remained in the study at 3 months; 86 ± 18 kg, n=41 in the egg group and 91 ± 16 kg in the cereal group, n=46. Weight loss (5.2 ± 4.5 kg egg group versus 5.2 ± 2.8 kg cereal group) was not different between the groups. Percent weight loss was 5.5 ± 4.0% in the egg group and 5.5 ± 2.8% in the cereal group.
Vitamin D concentrations (64 ± 19 nmol/L, n=38 in the egg group and 65 ± 18 nmol/L in the cereal group) were not different between the groups.

2.4 Outcomes at 6 months

Seventy-six participants completed the study (33 in the egg group and 43 in the cereal group). Weight loss in completers was 8.1 kg (± 7.0 kg) in the egg group and 7.3 kg (± 4.0 kg) in the cereal group. Analysis by repeated measures ANOVA showed a significant effect of time (P< 0.001) with a diet by time effect that was not significant (p= 0.56). Gender and baseline BMI had no significant effect when added as covariates. The egg group had 2 individuals with very large weight losses of >20kg which made the data skewed. Removal of these 2 individuals normalised the data and had no effect on the results but the egg weight loss was lower at 6.7 (± 4.6) kg. The percentage weight loss was very similar in the normalised group with 7.9% for the egg group and 7.6% for the cereal group. Weight loss had no effect on glucose and lipids which were all very normal to begin with. Vitamin D rose at 3 months and fell at 6 months but remained higher than baseline (P< 0.001 for time). There was no difference between the two groups (p=0.098 for diet by time). Vitamin D levels were inversely correlated with BMI (r= 0.22, p= 0.025) and positively with age (r= 0.26, p= 0.009) and change in vitamin D was positively correlated with weight change at 3 and 6 months (r= 0.46 and r= 0.41 both p< 0.001).
Compliance: All 76 participants who completed the study completed the compliance checklists. Overall compliance to both breakfasts was approximately 95% assessed from compliance checklists completed by the participants.

2.4.1 Weight loss

Weight loss in completers was 8.1 kg (± 7.0 kg) in the egg group and 7.3 kg (± 4.0 kg) in the cereal group. There was no difference between the groups.
Percent weight loss was 8.8 ± 6.4% in the egg group and 7.6 ± 4.6% in the cereal group.

2.4.2 Glucose concentrations

Glucose concentrations did not change (5.1 ± 0.7 to 5.1 ± 0.5 mmol/L in the egg group versus 5.0 ± 0.8 to 5.2 ± 0.7 mmol/L in the cereal group).

2.4.3 Lipids

Total cholesterol concentration

There was no change in total cholesterol levels (5.4 ± 0.8 to 5.4±1.0 mmol/L egg group and 5.4 ± 0.8 to 5.3 ± 0.9 mmol/L in the cereal group).

HDL cholesterol concentration

There was no change in HDL-cholesterol levels (1.5 ± 0.3 to 1.5±0.3 mmol/L egg group and 1.5 ± 0.3 to 1.4 ± 0.3 mmol/L in the cereal group).

LDL cholesterol concentration

There was no change in LDL cholesterol levels (3.4 ± 0.7 to 3.4 ± 0.8 mmol/L egg group and 3.4 ± 0.7 to 3.3 ± 0.9 mmol/L in the cereal group).

Triglyceride concentration

There was no change in triglyceride levels (1.2 ± 0.4 to 1.1±0.4 mmol/L egg group and 1.2 ± 0.5 to 1.2± 0.5 mmol/L in the cereal group).

2.4.4 Vitamin D concentrations

Mean vitamin D was within the normal range at baseline. It rose at 3 months and fell at 6 months but remained higher than baseline (P< 0.001 for time). There was no difference between the two groups (p= 0.098 for diet by time). Vitamin D levels were inversely correlated with BMI (r= -0.22, p= 0.025) and positively with age (r= 0.26, p= 0.009) and change in vitamin D was positively correlated with weight change at 3 and 6 months (r= 0.46 and r= 0.41 both p< 0.001).

Baseline	3 Months	6 Months
Egg group		
52.9 ± 15.7 nmol/L	65.8 ± 1.64	58.3 ± 20.0 nmol/L
Cereal group		
56.7 ± 17.0 nmol/L	64.7 ± 17.0 nmol/L	58.6 ± 1.4 nmol/L

More than 70% of the participants were obese (79 of 110) with BMI 36.3 ± 5.8 kg/m^2. In a post-hoc analysis when only obese participants were included in the analysis of vitamin D there was an effect of time (p< 0.01) and a time by diet interaction (p< 0.04) such that participants on the egg diet maintained the increase in vitamin D levels seen in both groups at 6 months.

		Mean	SD	N
Baseline Vitamin D	Eggs nmol/L	51.7	16.8	22
	Cereal nmol/L	56.2	18.2	29
Vitamin D at 3 months	Eggs nmol/L	66.2	19.7	22
	Cereal nmol/L	64.8	17.6	29
Vitamin D at 6 months	Eggs nmol/L	59.3	22.2	22
	Cereal nmol/L	56.7	17.4	29

2.4.5 Body composition

Body composition (lean and fat mass) by DEXA was measured at baseline but could not be measured at 6 months because of restrictions imposed by COVID-19.

Egg group n=39	**Cereal group** n=40
Fat Tissue	Fat Tissue
41.5 ± 14.1 kg	42.7 ± 11.8 kg
Lean	Lean
48.1 ± 10.9 kg	49.3 ± 9.4 kg

2.5 Discussion

The main finding of this study was that eating two eggs for breakfast resulted in a similar weight loss compared with cereal for breakfast in an energy restricted diet. There were no adverse effects on total or LDL cholesterol. Overall lipids and glucose did not change. Vitamin D levels rose at 3 months but declined at 6 months but remained higher than the baseline value.

The weight loss seen in this study is consistent with the weight loss seen in other studies (Noakes, Keogh et al. 2005). Noakes et al demonstrated weight loss of 7.3 +/- 0.3 kg on either a higher protein diet or a lower protein diet. This publication formed the basis of the successful CSIRO Wellbeing Diet.

Egg cholesterol elevates LDL cholesterol to a small degree. A meta-analysis by Berger et al 2015 showed that increasing dietary cholesterol from a mean of 214 up to 821mg/day (about 3 eggs) increased LDL cholesterol by about 0.2 mmol/L (Berger, Raman et al. 2015). Thus, an increase of two eggs per day for 5 days per week might increase LDL cholesterol by 0.10 mmol/L which would not be measurable, nor would it have any significant effect on CVD risk. Most data on egg consumption and CVD events in normal subjects has shown no relationship. However a recent paper (Zhong, 2019) of a pooled analysis of six US studies showed each additional half an egg consumed per day was significantly associated with higher risk of incident CVD (adjusted HR, 1.06 [95% CI, 1.03-1.10] and all-cause mortality (adjusted HR, 1.08 [95% CI, 1.04-1.11) (Zhong, Van Horn et al. 2019) which was very similar to that seen by Li et al (Li, Zhou et al. 2013). A larger meta-analysis by Shin et al found no relationship between egg consumption and CVD nor was any seen in the Physicians Health Study although a relationship with total mortality was noted (Djousse and Gaziano 2008, Shin, Xun et al. 2013). On balance the possible relationship between eggs and CVD risk remains unproven.

Participants enrolled in the study between September and December 2019. Therefore, participants commenced the study either at the end of winter, during spring and at the beginning of summer. Vitamin D at 3 months was then measured either at the end of spring, at the beginning and end summer or early autumn. The changes in vitamin D are likely to be related in part to the season in which it was measured and in part to weight loss. It is of interest that in a post-hoc analysis when only obese participants were included in the analysis of vitamin D, participants on the egg diet maintained the increase in vitamin D levels seen in both groups at 3 months. This remains to be clarified in a prospective study in obese participants only.

There are some limitations to the study that should be considered. There was a high drop-out rate of

30% which may have been influenced by the advent of COVID-19. Longer studies often have a higher drop-out rate and we have seen drop-out rates of 56% in a 12-month study and 67% by 24 months (Headland, Clifton et al. 2019). In contrast in a 3-month weight loss study in people with type 2 diabetes we had a drop-out rate of 19% (Carter, Clifton et al. 2016). In the present study 23 people (21%) had dropped out by three months.

Dietary composition and energy intake were not assessed as food records were not kept. We were concerned that food records would increase attrition from the study as they impose an extra burden on participants and are often poorly completed.

The study was conducted in participants with normal glucose and lipids. Nevertheless, it is surprising the LDL cholesterol did not reduce given the 8% weight loss. Greater changes in lipids and glucose levels might have been observed with weight loss if levels had been abnormal at baseline.

A strength of the study is that both eggs and the breakfast cereal were provided for approximately half of the study until the advent of COVID-19 following which vouchers were provided so individuals could purchase these foods during their usual grocery shopping.

2.6 Conclusion

Both eggs and cereal eaten for breakfast during an energy restricted diet resulted in similar weight loss. There were no adverse effects on total and LDL cholesterol which did not change.

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Plain English Summary

Project Title:	Eggs for breakfast: acute satiety responses and long term impact on body weight
Australian Eggs Limited Project No	21NM902
Researchers Involved	J. Keogh, P. Clifton
Organisations Involved	University of South Australia, GPO Box 2471, Adelaide, SA, 5001
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Objectives	The aim of the study was to investigate the impact of consuming 2 eggs for breakfast on 5 days per week compared with eating cereal for breakfast over a 6- month period on body weight, body composition, glucose and lipids and Vitamin D status.
Background	Project requested by Australian Eggs Limited to investigate the above Objective
Research	This was a randomised parallel study of two energy restricted diets comparing eating 2 eggs for breakfast on 5 days per week compared with eating cereal for breakfast over a 6- month period. Both diets had a similar energy content. Participants attended the UniSA's Clinical Trial Facility (CTF) in the morning having fasted overnight for the measurement of weight, height and to have blood samples taken
Outcomes	The primary outcome of this study was weight loss. Secondary outcomes were body composition, fasting blood lipids, glucose and Vitamin D status. Body composition (lean and fat mass) by dual energy X-ray absorptiometry (DEXA) was measured at baseline but could not be measured at 6 months because of restrictions imposed by COVID19.
Implications	76 participants completed the 6-month study. Weight loss was 8.1kg (±7.0kg) in the egg group (n=33) and 7.3kg (±4.0kg) in the cereal group (n=43). There was no statistical difference between the groups. The egg group had 2 individuals with very large weight losses of >20kg. Weight loss had no effect on glucose and lipids which were all very normal to begin with. Overall Vitamin D was normal at the start of the study (55±18 nmol/L) it rose at 3 months and fell at 6 months but remained higher than at the start. Vitamin D levels were lower in people who were more overweight and higher in older people. Change in vitamin D was positively correlated with weight change at 3 and 6 months. Both eggs and cereal eaten for breakfast during an energy restricted diet resulted in similar weight loss. There were no adverse effects on total and LDL cholesterol which did not change.
Key Words	Breakfast, energy intake, weight loss
Publications	To be determined